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# The Editor's Page

THE appointment of Dr. Emil Heuser as research associate and instructor in cellulose chemistry at the Institute of Paper Chemistry of Lawrence College, is commented upon by the *Paper Trade Journal* as follows, after referring to his "unusual combination of theoretical, and practical knowledge": "It is of particular significance that he should join the Institute staff at a time when the production facilities of the paper industry are increasing at an amazing rate and when one of the most important solutions of the problems presented by such increased production will probably be found in the further application of pulps of all kinds to other than normal uses, *i.e.*, paper making as such."

* * *

"FURTHER applications of pulps of all kinds to other than normal uses" may or may not include further substitution of paper for textiles, notwithstanding the large volume of cotton goods that has already been displaced by paper substitutes. The significant feature of this announcement for textile manufacturers, and particularly for the cotton branch of the industry, is that a large cross-section of the paper industry has found it profitable to invest substantial sums of money in basic and applied research, whereas but a relatively small number of textile manufacturers, either individually or by co-operative effort through U. S. Institute for Textile Research, have given evidence that they appreciate the potentialities of scientific research.

* * *

THE third Quarterly Research Number of the *American Dyestuff Reporter*, official organ of the American Association of Textile Chemists and Colorists, contains in addition to several reports of the latter's research associates, a number of papers delivered at its annual meeting, held in Philadelphia, Dec. 3–4. Among the latter is a paper by Dr. Milton Harris, research associate on the chemistry of wool, entitled "What Can the Mill Man Expect from Fundamental Research?" and a paper by W. D. Appel, chief, Textile Section, National Bureau of Standards, on "The Use of Standard Dyeings in Tests for Color Fastness to Light." Particularly noteworthy and valuable is a contribution from the laboratory of the Arlington Mills, Lawrence, Mass., by Frank J. Rizzo and Hugh Christison reporting the results of their research on "The Adsorption of Alcohols by Wool. A.—Studies on the System: Ethyl Alcohol-Wool." Abstracts of this and the other papers appearing in this issue will be published in the Abstract Section of TEXTILE RESEARCH.

* * *

## Personal

**William W. Buffum,** treasurer and general manager of the Chemical Foundation, Inc., has been elected to honorary membership in The American Institute of Chemists in recognition of his outstanding work in the field of chemical education.

**Daniel E. Douty,** president and general manager of the United States Testing Co., Inc., and a director of U. S. Institute for Textile Research, completed 25 years of service with the former company on January 1. During this period the company has expanded from modest quarters on Hudson St., New York City, to its own five-story office and laboratory building in Hoboken, N. J., and has 20 branches and sampling stations throughout the country.

* * *

**Alban Eavenson,** chairman of the board of Eavenson & Levering Co., Camden, N. J., was elected president of the American Association of Textile Chemists and Colorists at the recent annual meeting of that organization, succeeding William H. Cady. Mr. Eavenson was advanced from the office of first vice-president, and is succeeded by Duncan Ferguson, general manager of Sidney Blumenthal & Co., Shelton, Conn. Other officers elected are as follows: Arthur R. Thompson, Jr., Ciba Co., Charlotte, N. C., second vice-president; Harold C. Chapin, Lowell (Mass.) Textile Institute, secretary; William R. Moorhouse, National Aniline and Chemical Co., Boston, treasurer. Councillors-at-large elected are Dr. Harold DeWitt Smith, treasurer, A. M. Tenney Associates, New York, and Walter M. Scott, consulting chemist, Gustavus J. Esselin, Inc., Boston.

* * *

**Dr. Joseph F. X. Harold** was elected president of the American Association of Textile Technologists at the recent annual meeting of that organization, succeeding Harry Levine of the Textile Testing and Research Laboratories, who had served for two years and was elected a director for three years. Other officers elected were the following: H. H. Hatch, president, Hatch Textile Research, Inc., first vice-president; Dr. Vladimir Tuma, consulting chemist, second vice-president; R. E. Semmler, technician, Foreman Silks, treasurer; Beatrice S. Bronner, laboratory director, Brown Durrell Co., secretary.

* * *

**Dr. Emil Heuser,** research director of the Canadian International Paper Co., Hawkesbury, Ont., since 1926, has accepted appointment as research associate and instructor in cellulose chemistry at the Institute of Paper Chemistry of Lawrence College, Appleton, Wis., effective March 1. Dr. Heuser is well known in this country as author and lecturer on cellulose chemistry and related theoretical and practical subjects, and last year was chairman of the cellulose division of the American Chemical Society.

* * *

## Textile Tour of European Plants

A TOUR of textile mills, laboratories, machinery, and dye and chemical plants, also including a four-day visit at the Leipzig Trade Fair, is being organized by Dr. E. W. K. Schwarz, well known as a textile editor, author, and chemist, and at present technical director of the Arkansas Company, Inc., New York City. The tour is scheduled to sail from New York on the North German Lloyd S.S. *Europa*, Feb. 26th, and to sail on the

return trip from Cherbourg, April 8th, on the Hamburg-American S.S. *Deutschland.* Plants in Germany, Switzerland and Italy will be visited, and two days are allowed for sight-seeing in Paris. A folder containing full details of the tour may be obtained by addressing Dr. Schwarz, 233 Broadway, New York, N. Y.

* * *

## Science and Empiricism

**Lanital production** in Italy has been restricted, according to British reports, by the decreased domestic supply of its raw material, casein. Cheese has been in such active demand at high prices that Italian dairies have lost interest in the demand for casein. It is also reported that little of the foreign casein available has the high nitrogen content and certain other properties that are essential for its use in Lanital manufacture.

* * *

**Soya bean cake** is to supply vegetable albumen or casein for a "synthetic wool," similar to Lanital, that has been developed and is to be manufactured by the Showa Industry Co., Chigasaki, Japan. The company operates an oil refining plant and will supply the bean cake which is a by-product of oil extraction. Hideo Ito, the managing director of the plant and the inventor of this process of utilizing soya bean albumen for fibre, expects to produce the spun fibre at about half the cost of viscose spun rayon.

* * *

**The fisheries industry** as a source of raw material for fibre production was referred to in a recent lecture by Prof. Otto Mecheels, director of the Munich-Gladbach (Germany) textile research institute. While admitting that the invention is in an experimental stage, he stated that there is every reason to expect as successful results as have followed the use for fibre production of animal albumen or casein. Fish albumen, he stated, is more viscous than casein, and its molecule is larger, and therefore more suitable for fibre production.

* * *

**Regenerated silk filament** has been a dream of inventors for many years, but until recently their efforts had failed to produce a thrown yarn that was weavable. During the last six months sample lots of regenerated silk, the production of Kanebo, Inc., Japanese chemical manufacturers, have been used experimentally in dress fabrics, draperies, etc., by domestic manufacturers with reasonable success. The regenerated silk admittedly lacks the wet strength and elasticity of natural silk, but in coarse deniers can be used for filling. As fine as 100 denier is said to have been produced. Another Japanese firm, the Katakura Corp., is reported to be experimenting in regenerated silk production.

(*Continued to P. 140.*)

# The Acetylation of Silk Fibroin by the Action of Ketene. Part II

By EDWARD CARR *

*Fellow of the Textile Foundation*

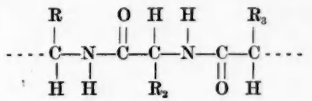
## Summary

1. *The study of the behavior of ketene towards silk fibroin has been continued.*
2. *The rate of absorption of ketene by fibroin increases with rise of temperature, and with increase of the concentration of ketene exposed to the fibre.*
3. *That ketene combines with the phenolic group of tyrosine, and the free α-amino groups in fibroin is evidenced by the failure of completely ketenized silk to respond to the characteristic Millon and Ninhydrin tests of protein respectively.*
4. *More ketene is absorbed by fibroin than can be accounted for by addition only to the known phenolic and free amino groups. The results of acetyl analyses of fibroin, saturated with ketene, indicate the presence of other unidentified groupings in the protein molecule capable of combining with ketene.*
5. *The degree of acetylation of degummed silk fibroin reaches a maximum or limiting value of about 7% of acetyl groups.*
6. *Exhaustive treatment of silk fibroin with ketene gas produces a tan coloration of the fibre.*

## Introduction

THIS is the second[1] in a contemplated series of reports on a research program having to do with the relationship between the structure and the properties of natural silk.

According to the modern conception of protein structure, silk fibroin is considered to consist of polypeptide chains of the general formula 1, where the radicals R are the so-called "side-chains" of α-amino



* Senior Research Fellow of the Textile Foundation, Inc., working under the direction of Prof. Treat B. Johnson, Sterling Professor of Chemistry, Yale University.

acids of the type formula (R) — $CH(NH_2)COOH$. The common and most characteristic atomic grouping of all proteins is considered to be the peptide linkage — $NHCH_2CO$ —, while it is generally held that the specific properties of a given protein are determined by the nature, number and arrangement of the side-chains R and the free amino and carboxyl groups.

On the basis of the α-amino-acids which have been isolated from silk fibroin [2] the principal side-chains of this protein are:

H, $CH_3$, $HO.C_6H_4.CH_2$, $C_4H_9$, $HO — CH_2$, $(CH_2)_3NHCH$, $C_6H_5CH_2$.

In addition to these side-chains, silk fibroin contains a large number of carboxyl groups and a small number of free amino groups.[3]

On the view that the characteristic properties of the silk protein are influenced by these various side-chains and active groups, it is of interest to seek to ascertain the effect of particular side-chains or groups on the properties of the fibre.

A logical approach to this problem would be (1) to establish criteria of the presence or absence of selected groups, (2) to devise means of rendering these groups inactive without destroying the fibre; and (3) to compare selected properties of the native and derived fibre.

In this report, as in the previous paper, established criteria are adopted to show the presence or absence of, (1) the tyrosine side-chain HO⟨⟩— $CH_2$, and (2) the free α-amino groups.

In the previous paper [1] it was shown that gaseous ketene reacts with silk fibroin to block these groups, as evidenced by the above criteria, without destroying the fibre. It is the purpose of the present paper to consider in more detail some of the characteristics of the reaction between ketene and silk fibroin, and to determine the limitation of the absorption.

## Experimental Part

*Silk Fibroin:* Raw Japanese white silk * in the form of skeins (70 grams) was degummed by boiling with a 2% solution of olive oil soap for 30 minutes. The skein was then boiled six times for 30 minutes with distilled water, wrung and oven dried. The dry fibres were soft and smooth without tendency to stick together.

Small skeins of spun silk weighing 5 grams were boiled three successive times for 30 minutes each with a 2% solution of olive oil soap, and six times for a period of 30 minutes with distilled water. These skeins were then wrung and oven dried (105°).

*Ketene:* Acetone was pyrolyzed as previously described.[1] A rate of flow of acetone vapor corresponding to about 5 cc. of liquid per minute through a Pyrex pyrolysis tube of 1″ to 1¼″ in diameter and 18″ in length maintained at 650–700°, resulted in about 20% decomposition of the acetone and yields of ketene of 25 to 40% of the acetone decomposed. The yields were determined as previously described.

The pyrolysis gas issuing from the condenser system was used in some of the experiments below without further purification. In some experiments, the ketene was further purified by passing the pyrolysis gas into a

* Supplied by Cheney Brothers, silk manufacturers, South Manchester, Connecticut.

receiver cooled by dry-ice and distilling the condensate so collected into a second similarly cooled receiver by allowing the ketene to vaporize at room temperature. About one-third of the volume of the first condensate collected at the temperature of dry-ice was volatile at room temperature. The liquid ketene remained practically colorless at the temperature of dry-ice.

In the experiment recorded in Table I, 5 gram skeins of spun silk were treated in a 5.5 liter desiccator. Pyrolysis gas was introduced into the evacuated desiccator containing the dry skein until the pressure was atmospheric. The desiccator was closed and left standing 4 hours, at the end of which time pyrolysis gas was again introduced until atmospheric pressure was restored and the desiccator left standing for 4 hours more. The skein was then removed, extracted with acetone and the treatments repeated.

TABLE I

Fibroin Treated with Pyrolysis Gas

| Exposure (hours) | Room Temperature % $CH_3CO-$ |
|---|---|
| 4 | 2.0 |
| 8 | 5.0 |
| 12 | 7.0 |
| 16 | 7.1 |
| 20 | 7.0 |

The treatment of fibroin with heated pyrolysis gas (ketene) was carried out in a 1-liter glass chamber maintained at the desired temperature by means of an electrically heated resistance coil. The portions of fibroin used were cut from a degummed skein of Japanese white, weighed about 1 gram and were 6–7 inches in length. The fibroin was dried at 105°, suspended in the chamber, the temperature adjusted and pyrolysis gas passed through for periods of 1 hour. At the end of an hour's treatment, the fibroin was extracted with acetone. Samples were given one or more such treatments as indicated in Table II.

TABLE II

Fibroin Treated with Acetone Pyrolysis Gas

| Time (hours) | % $CH_3CO$ 105° C | 125° C |
|---|---|---|
| 1 | 2.20 | 3.7 |
| 2 | 3.80 | 6.0 |
| 3 | 5.30 | 6.8 |
| 4 | 6.40 | 7.1 |
| 5 | 7.00 | 7.0 |
| 5.5 | 7.20 | |

*Treatment of Fibroin with Distilled Ketene at Room Temperature:* One gram portions of dry fibroin were exposed to distilled ketene as follows: The sample was suspended in a 1-liter glass chamber, the chamber evacuated and refilled with distilled ketene. The chamber was then closed and left standing.

In the experiment recorded in Table III, the exposure of the fibroin was continuous for the time recorded in the first column. After exposure, the fibres were extracted with acetone.

TABLE III

Fibroin Exposed to a Single Charge of Distilled Ketene

| Time (hours) | % $CH_3CO$ |
|---|---|
| 1 | 1.5 |
| 2 | 3.6 |
| 3 | 4.3 |
| 4 | 4.6 |
| 24 | 4.8 |

Tables IV and V record the acetyl values obtained on replenishing the charge of distilled ketene surrounding the fibroin after standing periods of 1 and 4 hours respectively. A separate 1-gram sample was used for each period of exposure listed in the second column.

TABLE IV

Ketene Replenished at 1-Hour Intervals

| Replenishments | Duration of Exposure (hrs.) | % $CH_3CO$ |
|---|---|---|
| 0 | 1 | 1.5 |
| 1 | 2 | 3.8 |
| 2 | 3 | 4.6 |
| 3 | 4 | 4.8 |
| 4 | 5 | 5.1 |
| 5 | 6 | 5.5 |
| 6 | 7 | 6.1 |
| 7 | 8 | 6.5 |
| 8 | 9 | 6.5 |
| 9 | 10 | 6.8 |
| 10 | 11 | 6.8 |
| 11 | 12 | 6.9 |

TABLE V

Ketene Replenished at 4-Hour Intervals

| Replenishments | Duration of Exposure (hrs.) | % $CH_3CO$ |
|---|---|---|
| 0 | 4 | 4.6 |
| 1 | 8 | 6.8 |
| 2 | 12 | 7.3 |
| 3 | 16 | 7.1 |

Table VI records the results of treating a single portion of fibroin repeatedly in the following manner: The dry fibroin weighing 3 grams was exposed to a charge of ketene for 1 hour, removed from the exposure chamber and extracted with acetone.

After taking a portion for acetyl analysis and tests, the remainder was dried at 105° and again exposed to ketene as before.

Table VII summarizes the acetyl values of Tables I, II, III and VI, and brings out three facts: (1) the acetyl value reaches a limit; (2) the rate of acetylation is increased at higher temperatures; (3) the rate of acetylation is increased at higher concentrations of ketene.

The colors of the various ketenized samples after extraction with acetone were graded in shades of tan the depth of which increased with increasing acetyl value.

The tan color acquired by the fibres is one of the most characteristic effects of treating fibroin with acetone pyrolysis gas or with distilled gaseous ketene. When exposed to these gases at room temperature, the fibres always become more or less discolored with the brown product of the polymerization of the ketene. This color effect is evidenced by the moist brown appearance and sticky feel of the fibres.

## TABLE VI

Repeated Treatment of Fibroin with Ketene for 1-Hour Periods

| Treatments | % $CH_3CO$ |
|---|---|
| 1 | 1.3 |
| 2 | 3.7 |
| 3 | 4.3 |
| 4 | 4.7 |
| 5 | 5.2 |
| 6 | 5.6 |
| 7 | 6.2 |
| 8 | 6.8 |
| 9 | 7.1 |
| 10 | 7.1 |
| 11 | 7.3 |
| 12 | 7.2 |
| 13 | 7.0 |
| 14 | 7.2 |

## TABLE VII

Acetyl Values of Ketenized Fibroin

| | Pyrolysis Gas | | | Distilled Ketene | |
|---|---|---|---|---|---|
| Exposure (hours) | Rm. Temp. | 105° | 125° | Continuous | 1-hr. exp. |
| 1 | | 2.2 | 3.7 | 1.5 | 1.3 |
| 2 | | 3.8 | 6.0 | 3.6 | 3.7 |
| 3 | | 5.3 | 6.8 | 4.3 | 4.3 |
| 4 | 2.0 | 6.4 | 7.1 | 4.6 | 4.7 |
| 5 | | 7.0 | 7.0 | | 5.2 |
| 6 | | | | | 5.6 |
| 7 | | | | | 6.2 |
| 8 | 5.0 | | | | 6.8 |
| 9 | | | | | 7.1 |
| 10 | | | | | 7.1 |
| 11 | | | | | 7.3 |
| 12 | 7.0 | | | | 7.2 |

Extraction of the brown fibres with acetone, ether or alcohol yields an amber colored extract, leaving the fibres with a lustrous tan color and a soft and dry feel. After extracting the fibres for a certain period of time, which varies from one to several hours depending on the amount of resinous material present, further extraction does not affect the tan color.

Washing the contaminated fibres with water renders them dirty in appearance and only slightly improves their feel. If the water wash is followed by extraction with acetone, the fibres are brought to a lustrous shade and dry feel.

When exposed to acetone pyrolysis gas at 105° the fibres remain practically dry to the touch but acquire the tan color described above. Acetone extraction removes some color from these fibres but scarcely affects the shade. Exposure at 125° severely weakens the fibres, rendering them practically friable after 2 hours.

*Treatment of Fibroin with Ketene in Ether Solution:* Liquid ketene was vaporized into anhydrous ether cooled with a mixture of dry ice and ether. The solution was allowed to come to room temperature. Ketene tends to escape from its ether solution at room temperature but a concentration of 3% was conveniently prepared. The concentration of ketene was determined by adding a portion of the solution to standard alkali and titrating the excess alkali.

One gram of finely shredded fibres was sifted into 100 ml. of the above solution containing 3.4 grams of ketene. Duplicate reaction mixtures were tightly corked and shaken at intervals over periods of 4 and 8 hours respectively. The pressure within the flasks diminished. The ether solution was filtered off and the fibres well washed with ether. The filtrate was of an amber color while the fibres were of a cream color.

Millon's test was entirely positive for both portions of fibres. The ninhydrin test was weaker than for pure fibroin. An acetyl analysis failed to show the presence of acetyl groups.

One-half gram of dry finely shredded fibres kept in contact with liquid ketene at the temperature of dry-ice for two hours gave the same acetyl analyses, Millon and ninhydrin tests, as pure fibroin.

All of the acetyl analyses were carried out as previously described,[3] and tests for the blocking of tyrosine hydroxyl and amino groups applied as described below.

*Millon's Reagent as a Criterion of the Esterification of the Tyrosine Hydroxyl Groups in Silk Fibroin:* Lassaigne [4] reported more than 100 years ago that silk is colored red by the solution obtained on dissolving mercury in nitric acid. This color test, generally applied to proteins and now known as the Million test,[5] is recognized as depending on the presence of a benzene phenolic group which is not protected by substitution in both *ortho* positions.

The α-amino acid, tyrosine, $HOC_6H_4CH_2CH(NH_2)COOH$, which is present in silk and most proteins, contains such a free phenolic group and gives the characteristic Millon color reaction. The color imparted to proteins by the Millon reagent is attributed to the presence of tyrosine and has been adopted in the present work as the criterion of the presence of free tyrosine hydroxyl groups in silk fibroin.

The preparation of Millon's reagent is variously described in the literature. Most of the directions recommend dissolving mercury in concentrated nitric acid in such proportions that the resulting reagent is strongly acidic with nitric acid. If the reagent contains too much free nitric acid, fibroin either may not develop the red color, or may develop it weakly. The failure of the Millon test in a strongly acidic solution is apparently due to two simultaneous actions of the nitric acid: (1) its action purely as an acid; (2) its action as a nitrating agent. The first of these actions is demonstrated by the instability of the color in strong non-nitrating acids, for example hydrochloric acid or concentrated acetic acid.

The effect of the nitrating action of certain Millon reagents is shown by first treating pure fibroin with the proper concentration of nitric acid

and then applying the reagent. Under certain conditions the color test fails completely while under others it is weakened.

In the present tests it was desired to obtain the color as quickly as possible under mild conditions in order to minimize secondary effects of the Millon reagent, such as a possible uncovering of unacetylated portions of the protein, or the removal of acetyl groups by the hydrolytic action of the reagent. Thus, if the surface phenolic groups were blocked by acetylation, but the Millon reagent tended to expose a new unacetylated surface beneath, or hydrolyze off acetyl groups, it is obvious that the color test would be unsatisfactory.

Nasse[6] minimized the acidity of the Millon reagent by using a solution of mercuric acetate and acetic acid to which he added a soluble nitrite at the time of use. This reagent has the disadvantage that the color is produced very slowly at room temperature.

In consideration of these factors, the Millon reagent employed in the present tests was prepared as follows: One gram of mercury was dissolved in 6 ml. of nitric acid of specific gravity 1.41, without the application of heat. All the mercury goes into solution with the development of heat. Twelve ml. of water are added and the resulting precipitate just redissolved by dropwise addition of nitric acid.

When pure white silk fibroin is covered with the above reagent at room temperature, a pink color is discernible on the fibres at the end of 30 seconds. The color gradually deepens and is a strong red at the end of 3 minutes. In 10 minutes, the color practically reaches its maximum depth.

Silk fibroin which has been treated with ketene until its acetyl value is about 7% has a characteristic tan color. Such a ketenized fibroin in contact with the above Millon reagent shows no change in 3 minutes. In 10 minutes, during which time pure fibroin has attained its maximum of color, the ketenized sample has become more orange in color. At the end of 30 minutes a reddish cast is definitely discernible on the fibre. In three hours the sample has developed a strong red color which gradually deepens in the course of several more hours until it cannot be distinguished from that developed by pure fibroin. Even the most protractedly ketenized fibroin eventually develops the red color. Hence, the most conclusive distinction which the Millon reagent is capable of giving in such comparative tests is afforded in the initial period of time during which pure fibroin attains its maximum color.

On this basis in these exptriments, a ketenized sample of fibroin is judged as giving a negative Millon test if it does not show a red color in the time required for pure fibroin to develop its maximum of color.

This definition of a negative Millon test on ketenized fibroin differs slightly from that given in the previous paper, but only in the direction of a greater refinement of the test by more sharply defining the time at which the test is judged. Thus, in the previous paper a ketenized fibroin having an acetyl value of about 5% or greater was judged as giving a negative Millon test, whereas, in the present tests only those samples which have an acetyl content of about 7% are judged as giving a negative Millon reaction. For acetyl values below about 7% the Millon test is positive in a rough proportionality to the acetyl value. In spite of the care required in performing and evaluating the Millon test in the case of acetylated fibroin, the difference between the behavior of an acetylated sample and that of pure fibroin is definite.

The tan color which is imparted to white silk fibroin by treatment with ketene ($CH_2CO$) conceivably may arise from one or both of two different causes: (1) it may be associated with the deposition upon the silk fibres of the brown polymerization product of ketene. It would thus be interpreted as a phenomenon of surface adsorption of the polymerized ketene, and such an adsorption might well account for the tan color of the fibre and at the same time inhibit the normal action of Millon's reagent. (2) It is also entirely possible that the tan color might result from the combination of ketene or its polymerization product with a special grouping functioning in the protein molecule, besides the known hydroxyl and amino groups, giving a tan colored compound. The even distribution of this color through the fiber and its permanency during washing support such a view. It is entirely possible that this protein molecule contains organic constructions which have not hitherto been detected, and that ketene fortunately reacts to reveal such a grouping.[10] It is our intention to investigate further this supposition by applying some new experimental technique stimulated by and coordinating with this second viewpoint.

It was found that the color of ketenized silk fibres could be produced by staining fibroin with the ketene polymerization product. Even when the brown material was first made alkaline in order to eliminate the possibility of any acetylating action, it still colored the fibres as does direct ketenization. But the deliberately stained fibres react not the least less readily with Millon's reagent than does pure fibroin. Therefore, if the tan color of ketenized silk is the same as that imparted to the fibres by the polymerization product, it might be concluded that the inhibition of the Millon reaction is due to acetylation and not to mere physical interference.

It appears from the above observations that when fibroin is exposed to the action of gaseous ketene, two reactions actually may occur simultaneously: (1) acetylation of active groups in the protein; (2) a condensation of ketene with the fibre, forming a brown stain without blocking of either the tyrosine hydroxyl or amino groups. Whether an unknown grouping of the fibroin is responsible for this coloration, remains to be established by further experimentation.

Millon's test on ketene-treated fibroin indicates that the tyrosine hydroxyl groups are acetylated with difficulty. The fibres continue to give a positive Millon test until the acetyl value has reached its limit of about 7% Fibroin with acetyl values below about 3% gives the same Millon test as pure fibroin. For increasing acetyl values above 3%, the red color imparted to the fibres by the Millon reagent steadily decreases and finally vanishes for an acetyl value of 7%.

*The Ninhydrin Reagent as Criterion of the Blocking of Free Amino Groups:* Ruhemann[7] discovered that all acids containing a free amino group in the $\alpha$ position give a blue color with triketohydrindene hydrate under certain conditions, but that such acids, substituted on the amino or carboxyl group do not react with this reagent. Harding and MacLean [8] developed this reaction into a quantitative method for determining $\alpha$-amino acids. Kise[1, 9] adapted the reaction to the estimation of amino nitrogen in colloidal solutions of silk fibroin, and to the detection of free amino groups in the silk fibre.

When pure silk fibroin is treated with ninhydrin (triketohydrindene hydrate) under the conditions described by Harding and MacLean, the

solution of the reagent surrounding the fibres acquires a deep blue color. When, however, a ketenized sample of silk fibres having an acetyl value of as high as about 3% is treated with ninhydrin, the solution does not acquire a blue color, and prolonged heating of the test mixture does not serve to develop the color. The ninhydrin test, therefore, differs from the Millon test in that it gives a much sharper distinction between the free and blocked groups involved. The proportion of free amino nitrogen in silk fibroin, however, is very small amounting to not more than 0.1%, while the proportion of tyrosine in fibroin is of the order of 10%.

The further study of acetylated fibroin is in progress in this laboratory with the objective in view of determining the effect of acetylation on various properties of the silk fibre: namely, the absorption of acid and basic dyestuffs, the hygroscopic properties, the electrical insulating properties, and the light-stability of the acetylated fibres.

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*"There is no great probability that the complicated machinery of the tiny silkworm was designed to produce from mulberry leaves a product so well fitted for every changing human service that better products might not be found. One naturally looks for such discoveries to those experimenters who already know the applications and the limitations of existing products, so that each industry should be inquisitive."*—Willis R. Whitney.

# Problems Which Abrasion and Wear Testing Present

By HERBERT J. BALL*

*This is Part II of a paper read by Prof. Ball, who is Chairman of Committee D-13 of the American Society for Testing Materials, at the Papers Session of that Committee held in New York City, Oct. 21, 1937.*

*Part I was devoted to a description of the mechanical features, and essential information as to the operation of a selected list of 11 abrasion and wear testing machines. Part I was published in the December, 1937, Bulletin of the A. S. T. M.*

ARE the terms "abrasion testing" and "wear testing" to be considered as synonymous? It must be recorded that general usage does not appear to make a distinction between them. In the event, however, that it may seem desirable to establish a line of demarcation, the following suggestions are offered.

Abrasion, derived from the verb "to abrade," very distinctly suggests a "rubbing off." The word "abrasion" as an adjective might properly be applied therefore to those machines or tests in which rubbing is the only, or at least the major, characteristic.

The term "wear" is believed to be more closely associated with the thought of the conditions surrounding every-day use and service and implies the combined effect of several factors of which abrasion or rubbing is only one. A household or garment fabric may wear out from a variety of causes. Thus, a towel is discarded because it has broken down under the combined influences of abrasion, the application of tensile forces in a dry and wet state, and washing, drying, and ironing. The lining of a coat is worn out as a resultant of abrasion, perspiration, dry or wet cleaning, and pressing. It is suggested therefore that "wear" be considered as a broader scope than "abrasion" and be used to apply wherever other important destructive actions, with or without abrasion, are existent or are intentionally introduced by the machine or test method. If the above distinction is observed, most of the machines described in Part I would be called abrasion testers. Simon's "Perspirator" would be one example of a wear tester. In the remainder of this paper the suggested distinction will be observed.

The instances in which the wear of textile materials occurs are so numerous that interest in the subject is very widespread. The wear or serviceability furnished by the fabrics used for wearing apparel and in the household affects nearly every person and in some degree they are concerned with it (or concerned over it). The wear given by the so-called mechanical fabrics is of special interest to those many manufacturers who use them in their respective products or in the conduct of their manufacturing opera-

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tions. The interest in the subject of wear testing and the determination of service life is on the increase in both groups with the accentuation furnished by the household and garment fabric users. The manufacturers, with their engineering, research, chemical and testing laboratories and technicians, have been able to accumulate much reliable data regarding the suitability of textiles for their particular uses. However, the ultimate consumer of textiles in the form of dresses, suits, coats, hosiery, underwear, shirts, towels, sheets, blankets, carpets, rugs, draperies, curtains and upholsteries is not well equipped to secure such data for himself and must rely upon the information secured from the seller, manufacturer, commercial testing laboratories, governmental bureaus, textile schools, departments of home economics in the colleges, and those organizations especially representing consumer interests.

## No Universally Applicable Machine or Method

Much thought, time and expense have been devoted to the subject of wear testing and the development of wear testing machines, in some cases with the hope of finding a method or machine universally applicable. To ask the question "Can a standard wear test, applicable to all cases, be developed?" is to answer it; for to anyone who has given thought to the conditions producing wear, the negative answer is perfectly obvious. The elements of wear affecting carpets, for example, differ so greatly from those affecting a man's suit that it is entirely out of the question to consider a like test for each material. Even the fabrics used in the suit itself, the worsted cloth, the rayon lining, the cotton pocketing, are subject to conditions sufficiently different to cast a doubt upon the possibility of a single wear test for them alone.

Hence it would seem that each condition of wear must become a separate problem in itself, that a test must be devised for each particular set of service conditions to which a fabric is subjected. It is along this line that some wear testers have been developed. Simon's "Perspirator" is designed particularly to simulate the conditions to which coat linings are subjected. The Bureau of Standards carpet tester likewise closely duplicates the conditions to which carpets are subjected.

## Requirements of a Satisfactory Laboratory Test

The question is next raised as to how closely a laboratory wear test should duplicate an actual set of service conditions. If it attempts to reproduce all of them, it will certainly require in some instances a complicated machine and procedure. In any case, is not the answer rather to be found in the results of a preliminary but thorough investigation, one which has for its object the determination of the cause or causes of greatest wear? With this information at hand, the wear testing machine should be planned to reproduce only those influences which are accountable for the major portion of the total destructive effect. If, for example, the greatest deterioration comes from a rubbing or frictional cause, then possibly a simple form of abrasion tester will serve adequately to differentiate between the fabrics tested.

There is one important point to be kept in mind and that is the usual purpose of the tests. It is not required that they shall permit the forecast-

ing of the service life of a material in terms of some unit of time. Rather the problem is one of comparison, of determining such facts as will warrant an opinion that one fabric probably will or will not last longer than another. The question to be answered is as to which of two denims, for example, will probably give the longer life when made into a pair of overalls, and not as to how many months a pair of overalls made of either fabric will last. This limitation of purpose tends to reduce the requirements of wear testing and makes the problem one of producing the simplest apparatus which will rate the fabrics in their proper order. The selected procedure may or may not closely duplicate the actual conditions of use.

## Difficulties of Correlating Wear Rating With Service Tests

How is the proper order of wear rating to be established? It has been suggested that this be by proper correlation with service tests, by comparison with records of the actual service given by the fabric or article. This seems quite logical, but it may be in order to point out to those who contemplate its use that there are some difficulties connected with the assembling of reliable data. This is more particularly true of household and garment fabrics than of those used for mechanical purposes where conditions and records of use are under better control. Assume, for example, that the study is one that involves the serviceability of a certain dress material and that it is to be based upon the results of use by many wearers. It is easy to visualize some of the numerous variable conditions which will occur due to differences in the occupations of the wearers, their size and weight, degree of fit, amount and character of perspiration, oiliness of skin, frequency and character of cleansing of the article, and general severity of use. Further, if it should happen that a record were kept by the wearer, it will be exact or inexact only according to that person's own idea as to what constitutes an adequate record of facts.

It is not the intention to minimize the value of service tests, especially those deliberately planned, nor to suggest that complaints regarding unsatisfactory wear brought to the attention of the seller are to be ignored. They are undoubtedly of some value in disclosing major defects and major differences in quality. It does raise the question, however, as to their suitability for the distinction of closer differences, *unless* a representative sample of sufficient size is available to insure that the averages obtained have a suitable degree of reliability.

## Measure of Effects of Abrasion

How may the effects of abrasion be measured? We are here dealing with the problem of finding a means of evaluating the work done upon a textile by a frictional force. Its measurement should yield a quantity proportional to the effect of the frictional force; in other words the selected measure should be one that is reasonably sensitive and proportional to the work done upon the sample.

Various measures have been suggested of which the important ones are the changes produced in the (1) tensile strength, (2) thickness, (3) weight, (4) surface luster, (5) air permeability, (6) color, (7) character of abraded materials, and (8) appearance of surface. The first six represent properties which it is possible to measure physically, and this is a feature con-

sidered to be an advantage by those who prefer to have numerical values to back up their opinions of a fabric. The last two would be determined with the aid of a microscope, and possibly by comparison with established standards, but are of such a character that the personal equation enters to some degree in the formation of an opinion. Which measure should be selected for a particular investigation would primarily be governed by the nature of the service conditions of the cloth which is being tested. If, in actual use, it were the decrease in strength of a fabric that was the important criterion of its serviceability, it would be natural to select the change in strength of the test samples as a suitable means of rating the relative value of the fabrics under consideration.

There are, however, certain limitations to this basic selection of a measure which should be noted. The changes in certain of the properties mentioned above are not always in the same direction nor proportional to the work expended. Some fabrics, for example, first increase in thickness with increasing rubs, and then begin to decrease as the abrasion is continued. This is due to the cutting and breakage of the fibres and the teasing of them out of the yarn, resulting in a rough, fuzzy surface of greater thickness than the original, when measured under like conditions of pressure. Further abrasion finally reaches a point when these fibres become detached from the surface faster than new fibres are raised up and the thickness begins to decrease. Other cloths have such structures or yarns that they load with particles of the abradant and their own detritus. The result is an increase in weight in the early stages of a test, followed later by the anticipated decrease if the abrasive action is continued far enough. The permeability of a fabric to air depends upon the extent to which the test has progressed and the resultant degree of closure of the interstices with the roughening of the surface and with loading. While the fabric at first exhibits a decrease in permeability followed by an increase, another fabric may show a continuous increase from the start. Whereas it is observed that tensile strength almost always decreases with the number of abrasive strokes, it is not always in a manner proportional thereto.

The problems connected with abrasion or wear testing are so numerous that this paper would become of undue length if each was to be properly and fully discussed. It is hoped that the few points presented here will merely emphasize the extent to which care and judgment must be exercised in planning wear or abrasion tests and that even greater judgment must be used in interpreting their results.

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*"Some people consider research a dull and sleepy affair. To me, research is full of dynamite. In the hands of a competitor it can strew your own business paths with heart-breaking obstacles. Used by yourself, it can blast your way to success."*—**A. Lincoln Filene.**

# Research and the "Recession"

*Excerpts from Statement of* **Lammot du Pont,** *President, E. I. du Pont de Nemours & Co., Inc., before the Special Senate Committee to Investigate Unemployment.*

"SUCCESSFUL INDUSTRIAL RESEARCH undoubtedly creates new jobs. More than that, it creates new wealth in the form of new materials that are, necessarily, either better or cheaper than those they supplement or displace, and usually are both. The result is a wider distribution of goods and a higher standard of living. Rarely is research successful except through patient, sustained work over a period of years, during which substantial sums must be expended long in advance of any hope of return.

"Research demands long-term planning. Current outlays of money for its needs are aimed, in the main, at five, ten, or twenty years hence. Du Pont employment in 1937 was what it was, not because of that year's research, but because of money spent on research in 1932, 1930, and earlier. In line with long-established policy, this form of insurance on the future has been held intact by du Pont management regardless of the ups and downs of sales charts. How such a policy affects employment can best be clarified by citing actual examples.

## Long Road to a Profit Basis

"The du Pont Company entered the field of manufacture of chemicals by high pressure synthesis in 1926, commencing with the fixation of atmospheric nitrogen for the production of ammonia. This was done by the purchase of a process that had been developed in France. A plant was built at Belle, West Virginia, involving a large initial investment of capital.

"If we had been making shoes or suspenders, we might reasonably have expected some return on our investment at the end of a year or two of operation. What actually happened, however, was that for the next seven years the Belle plant became to all intents a laboratory of constantly expanding proportions. A vast amount of technical knowledge had to be acquired that could be gained only through actual operation experience. Early costs were prohibitively high. The process of manufacture finally evolved bore little resemblance to the process we had bought, except in its fundamentals, and it was not until the eighth year—1933—that the operation began to show profit. To date our capital investment has been increased ten fold. Large volume was the only road to profit, and, in turn, the one road to large volume was low price. In following those twin highways, the engineers and chemists effected five successive price reductions that brought down the cost of ammonia 40% in seven years. The price thus established in 1933 has held since, despite increases in both labor and raw material costs, with the result that industrial users and fertilizer manufacturers are today paying only half as much for fixed atmospheric nitrogen

as they did for the imported natural product prior to 1914. American producers are selling nitrogen for less per pound than any other producers in the world.

## Neoprene An Outstanding Example

"Take another example: Perhaps the most outstanding of all du Pont research developments, both from the scientific and economic viewpoints, is the rubber-like material to which has been given the name neoprene. Unlike rubber in chemical composition, neoprene is an entirely new engineering material that fits into no existing classification. It looks like rubber, acts like rubber, serves where rubber serves, and for innumerable uses it will outlast rubber by many times. The basic raw materials from which it is made are coal, limestone and salt, which we possess in abundance.

"Research that led our chemists to neoprene began also in 1926. Almost six years of intensive work preceded the initial manufacture of their discovery on a small scale at Deepwater Point, N. J. And until the end of the year just closed, neoprene was produced at costs considerably in excess of its selling price, which was first $1.05 per pound, then $1.00, and then 75c. as volume was progressively increased. Recently our chemists and engineers have been talking hopefully of neoprene's first profits—I said hopefully. Also they are talking—hopefully—of making a substantial addition to their present plant facilities. More than 200 manufacturers, including practically all of the principal producers of rubber goods, used neoprene in 1937, mainly for purposes that rubber itself could not serve satisfactorily, if at all.

## Improving Existing Products

"Research may serve employment as importantly by improving an existing product as by discovering a new one. Striking example of this fact is found in 'Cellophane' cellulose film. When introduced in America by du Pont, in 1924, through the purchase of the French patent rights, 'Cellophane' was a product with a limited field and many faults. However, when research had found ways to render 'Cellophane' moisture-proof, to strengthen it, and otherwise to adapt it to the needs of merchandizing, the new transparent wrapping material became a factor of first rank in all packaging. It inspired betterment of all wrapping materials, regardless of what made, and, significantly, more than paid its way by reducing losses suffered in many types of goods through spoilage and handling. The price history of 'Cellophane' is one of 18 successive reductions from $2.65 a pound to an average of about 41c. a pound in 1936. This was increased by ½c. last year. Since moisture-proofing was added in 1927, production has increased almost fifty fold.

## Most Important Factor in Creating Jobs

"The du Pont organization as a whole employed about 10,000 persons more on December 31 last than were employed by it nine years ago. It is my carefully considered opinion that research efforts such as those I have outlined are due more credit for the gain in jobs than any other one contributing factor.

"Moreover, in any estimate of the effect research has had on employment over this period, consideration must be given to the fact that general business was below a normal level. What the same effort might have accomplished under conditions more favorable is something on which we can't even speculate. We do know, however, that at the peak of du Pont employment last year we were 19,000 jobs ahead of the 1929 monthly average. The estimate has been made, I believe, that for every one man put to work in manufacturing industry, two and a half jobs are created in the so-called service occupations. If this is correct, the gain of 19,000 by du Pont companies was responsible for the employment of 47,500 persons elsewhere, making an overall gain of 66,500 new jobs.

"We can be prosperous only by serving better the diversified industries of America which use our products. We can hope to make a return on our investment only by continually developing new things for better living, which will on the one hand utilize the raw materials from farms, forests, and mines, and will on the other hand help other industries to employ more people and contribute to a higher economic development."

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(*Continued from P. 124.*)

**Regeneration of silk** for filament production may or may not make possible the utilization of silk wastes of various kinds. It does, however, eliminate reeling of the cocoons, the laborious and skilled process which has been the principal factor preventing successful silk production in countries having high labor costs. With reeling eliminated it is quite possible that another attempt will be made to revive silk worm culture in this country; provided, of course, there is a regenerated silk plant to use the raw material. Next in line may be an attempt to eliminate the lowly silk worm, and to synthesize its product from mulberry leaves, as did Count de Chardonnet unsuccessfully.

* * *

**The effectiveness of copper compounds** as mildew-proofing agents for cotton fabrics, particularly when used as constituents of mixtures for the mineral dyeing of cotton duck, has been studied by the Bureau of Chemistry and Soils, U. S. Department of Agriculture, and a booklet descriptive of the experiments and results can be obtained by addressing the Bureau.

* * *

*Naupactus leucoloma* is a new weevil which was found to be destroying cotton and a number of other crops last season in Alabama and Florida. It has been identified as a native of South America, and does most of its damage in the larval stage, feeding on the plant roots. The adult beetles appear in late June and feed on foliage before depositing their eggs in the soil. The female of this species is more deadly than the male, for thus far, according to the Bureau of Entomology and Plant Quarantine, no males have been located. Therefore, a single grub or beetle inadvertently carried from an infested area can start a new infestation.

# Abstracts

**Committee on Abstracts and Bibliography:**
**E. R. Schwarz, Chm., M. W. Weiss, Dr. I. J. Saxl, C. H. Clark.**

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## I. Fibres (Synthetic and Natural) and Fibre Analysis

Researches on the Fibre-forming, Acetone-soluble, Acetyl Cellulose. I. X-ray Diagrams and Mechanical Properties of the Films. I. Sakurada and I. Watanabe. *J. Soc. Chem. Ind., Japan*, Feb. 1937, P. 60B–61B; abs. in *Eastman Kodak Abs. Bull.*, Sept. 1937.

Fibre-forming, acetone-soluble acetyl cellulose forming a film having strength and extension properties similar to those of powder-forming, acetone-soluble cellulose acetate is described. Its X-ray diagram is very similar to that of triacetyl cellulose. (S)

Scientific Aspect of Carpet Wools. Walter Krauss. *Rayon Tex. Mo.*, 1937, Oct., P. 64–5; Nov., P. 64–5. (C)

Sheep Wool: Recent Discoveries in the Field of the Chemistry of. Otto Gronych. *Klepzig's Textil-Z.*, 1937, V. 40, P. 404–8; abs. in *C. A.*, 1937, V. 31, Col. 6468.

A review of the recent literature. Sixty references. (W)

Spun Rayon: Development and Properties of—and Its Importance in the Textile Industry. Jehle. *Monatsh. Seide Kunstseide*, V. 42, P. 297; *Spinner u. Weber*, V. 55, No. 31, P. 10; Deut. *Wollen-Gewerbe*, 1937, V. 69, P. 864; abs. in *C. A.*, 1937, V. 31, Col. 7658. (W)

STAPLE RAYON AND SOME NITROGENOUS FIBRES. Walter Wagner. *Österr. Chem. Ztg.*, 1937, V. 40, P. 369–73; abs. in *C. A.*, 1937, V. 31, Col. 8205.

A historical review of the development in the manuf. of staple rayon followed by a description of some recent methods therefor and some other substitutes, "lanital" made from casein in Italy, and "Carnofil" made from animal flesh in Germany. Three references. (W)

STAPLE RAYON: POSSIBLE ECONOMIES BY CONTINUOUS PROCESSING. H. Jentgen. *Tex. Mfr.*, Sept. 1937, P. 371. (C)

STRUCTURE OF THE SURFACE OF NATURAL AND RAYON FIBRES. H. Mark. *Monatsh. Seide Kunstseide*, 1937, V. 42, P. 266–8; abs. in *C. A.*, 1937, V. 31, Col. 6469. (W)

STRUCTURE OF PROTEIN FIBRES. Hans Philipp. *Umschau*, 1937, V. 41, P. 624–7; abs. in *C. A.*, 1937, V. 31, Col. 7654.

X-ray pictures of silk and its components are given, with suggested structure of mols. (W)

VISCOSE RAYON: EFFECT OF SPINNING CONDITIONS ON INTERNAL STRUCTURE. T. Tomonari and S. Nagai. *J. Cellulose Inst., Tokyo*, 1937, V. 13, P. 21–4; abs. in *J. T. I.*, Aug. 1937, P. A419.

The authors have spun viscose of the ammonium chloride numbers 12.2, 9.1, 8.0 and 7.1, each under three degrees of tension (weak, medium and high) into 120 den., 25 fil. yarns and then measured the extension on wetting, the degree of parallelism of the crystallites (Go and Kubo's X-ray method) and the breaking load and extension, wet and dry. The results are tabulated and graphed. In general, the smaller the extension on wetting, the greater is the degree of parallelism of the crystallites and the stronger the filament. The extension also decreases and parallelism and strength increase as the spinning tension increases, provided that the viscose is not over-ripe. A ripeness corresponding with the ammonium chloride number 9 is best. (C)

TEXTILE FIBRES: MOISTURE RELATIONS. A. Engeler, J. Friedle, H. Stäger and H. Tschudi. Schweizer Archiv, 1936, V. 2, P. 265–73 (through *Physikal. Ber.*, 1937, V. 18, P. 483); abs. in *J. T. I.*, Sept. 1937, P. A510.

Several series of experiments are reported that were designed to establish the conditions for the accurate measurement of moisture absorption by fibres. Factors to be observed are (1) the relative humidity should not be above 90%, (2) constancy of temperature, (3) a constant relationship between the size of the container, the amount of the salt solution (to provide the required R.H.) and the amount of fibre, (4) weighing should be done in the apparatus itself, and (5) the sample should be stored for a sufficient length of time, in which case circulation of the air is unnecessary. (C)

TWISTED RAYON STAPLE FIBRES: STRENGTH AND EXTENSION. E. Husung. *Monatsh. Seide u. Kunstseide*, 1937, V. 42, P. 215–8, 273–6; abs. in *J. T. I.*, Oct. 1937, P. A573. (C)

X-RAY ANALYSIS OF THE STRUCTURE OF JUTE FIBRES. S. R. Das. *Science and Culture*, 1937, V. 2, P. 652–3; abs. in *C. A.*, 1937, V. 31, Col. 7660.

A preliminary notice. Jute has a fibre period of 10.29 A. in agreement with the accepted value for native cellulose. (W).

WOOL: ACTION OF LIGHT ON. 1. Titration Curves of Intact and Exposed Wools. P. R. McMahon and J. B. Speakman. *Trans. Faraday Soc.*, 1937, V. 33, P. 844–9; abs. in *C. A.*, 1937, V. 31, Col. 6889. (W)

## II. YARNS AND FABRICS

CONTRACTION GRAPHS. Gilbert R. Merrill. *Cotton*, July 1937, P. 47.

The author plots two graphs based upon data in "Rayon Crêpe Yardage Tables" published by the Liberty Throwing Co. One graph shows contraction vs. twists per inch for six different deniers and twists ranging from 15 to 40 turns per inch, the curves all having the same general trend, but the coarser yarns contracting more than the finer with any given twist. The curves of the other graph represent an effort to correlate the preceding data with that of twist contraction for single cotton yarns, deniers being converted to equivalent cotton counts and contractions being plotted against twist multipliers. The two curves follow each other closely, the maximum divergence being only 1.5%. (C)

(COTTON) MACHINES AND PROCESSES. Wm. McLeod Fraser. *Am. Wool & Cotton Rptr.*, Oct. 14, 1937, P. 22, 31–7.

Address at convention of National Association of Cotton Manufacturers, Providence, R. I., Oct. 1937. (C)

COTTON RESEARCH. Anon. *Tex. Wld.*, Oct. 1937, P. 82.

Describes organization and purposes of the recently-formed Cotton Research Foundation, with headquarters in Memphis, Tenn., which has established an industrial fellowship at Mellon Institute for the development of new uses for cotton and its products. (C)

COTTON SPINDLEAGE: FUTURE OF. A. W. Benoit of Charles T. Main, Inc. *Am. Wool & Cotton Rptr.*, Oct. 21, 1937, P. 11–12.

Part of a paper presented at regional meeting in Cambridge, Mass., of the Textile Division of the A. S. M. E., of which Mr. Benior is chairman. Based upon the trend of the last 11 years, and the tendency to operate spindles a greater number of hours, the author indicates that several million more spindles must be scrapped before the industry is stabilized. (C)

DEFECTS DEVELOPED DURING WOOL CLOTH FINISHING. Eber Midgley. *Tex. Mfr.*, Sept. 1937, P. 372–74.

Prevention of faults is to the general interest and systematic investigation is recommended. Classes of faults are illustrated by actual examples. (C)

DELUSTERED RAYON YARN OR FABRICS. H. Roche. *Tex. Col.*, Oct. 1937, P. 673–76 (reprinted from *Tex. Mfr.*).

A review of recent methods of producing delustered viscose or acetate yarns by treatment of spinning solution, yarn or fabrics. (C)

DEVAUS SYSTEM OF HIGH-DRAFT COTTON SPINNING. *Tex. Mfr.*, Sept. 1937, P. 362.

The problem of using very small diameter rollers is solved by adopting magnetic steel rollers. (C)

DEVELOPMENT OF (COTTON) MACHINERY. Robert J. McConnell. *Am. Wool & Cotton Rptr.*, Oct. 14, 1937, P. 35, 49–52.

Address at convention of National Association of Cotton Manufacturers, Providence, R. I., Oct. 1937. A brief historical review of developments since 1855, the last and most important of four periods since then having started about 1914. Emphasizes present improved machinery characteristics and construction methods. (C)

TWIST IN SPUN RAYON. Anon. *Am. Wool & Cotton Rptr.*, July 1, 1937, P. 7–8, 15–16.

Describes the manufacturing methods and problems involved, and a series of tests made for comparison with filament yarns. Indicate that additional research is needed accurately to define the different characteristics of these two types of yarn. (C)

TWIST EFFECT ON TWO-PLY SPUN RAYON. *Am. Wool & Cotton Reporter*, July 15, 1937, P. 7–8, 40.

Comparative tests of 20s and 16s cotton basis yarns made from about 2-in. staple. Tensile strength, elongation and percentages of yarn contraction are given. (C)

WATERPROOFING OF TEXTILES. James F. Holmes. *Tex. Col.*, Aug. 1937, P. 517–19, 560.

A review of methods, including recent patented processes, and also of methods of testing water repellancy. (C)

WATERPROOFING: TREATMENT OF RAYON AND CELLULOSE ACETATE SILK. Ray Mitcheson. *Dyer and Tex. Printer*, April 9 and May 7, 1937; abs. in *Rayon Tex. Mo.*, Oct. 1937, P. 102.

Explains the two- and one-bath methods and substances used, such as aluminum acetate, wax, gelatin with formaldehyde, linseed oil, etc. Describes one-bath method using certain proprietary compounds with water as the continuous phase. Gives a list of nine definite advantages of these compounds. More data is supplied on stability to salts and acids; tests for quality of water-proofing; and remarks regarding the synthetic waxes. (C)

WOOL: PRESERVING SOFTNESS IN. THE REACTION OF WOOL TO VELAN AND SAPAMINE KW. *Tex. Recdr.*, Nov. 6, 1937, P. 48–9. (C)

WORSTED COMBING AND SPINNING: ORGANIZATION IN. K. L. Stephens. *Tex. Mfr.*, Nov. 1937, P. 436–37, 400.

An outline analysis of the costs in worsted scouring, combing, drawing and spinning, and the importance of various cost factors in production of tops and yarn. (C)

## III. Chemical and Other Processing (Not Otherwise Classified)

Affinity of Fibres for Dyes: New Methods of Modifying the. A. Patterson. *Tex. Col.*, Oct. 1937, P. 665–66, 708. (C)

Alkalies upon Regenerated Cellulose in Relation to the Mercerization of Mixed Cotton and Staple-rayon Fabrics: Effect of. H. Rath, C. Kubitzky, W. J. ter Kuile and K. Jaeger. *Kunststoff.*, 1937, V. 5, P. 26–9, 43–6, 63–8. (W)

Alkaline Treatment and Bleaching: Histological Structure of the Cotton Fibre in Photomicrographs and the Behavior of the Cotton Cuticula during. H. Reumuth and W. Köhler. *Klepzig's Textil-Z.*, 1937, V. 40, P. 401–4; abs. in *C. A.*, 1937, V. 31, Col. 6470.

Ten photomicrographs are shown and the effects of alk. treatment and bleaching upon cotton are discussed. (W)

Anti-crease Finish: Producing. "Chemitex." *Tex. Recdr.*, Aug. 6, 1937, P. 41, 43.

How synthetic resins and nitrogen compounds may help the cotton dyer. (C)

Barium Activity Determinations: Effect of Aniline Black on. Sidney M. Edelstein. *Am. Dye. Rptr.*, July 26, 1937, P. 460. (C)

Black-logwood Dyeings: Change in Color of—During Carbonization. W. Manecke. *Klepzig's Textil-Z.*, 1937, V. 40, P. 445; abs. in *C. A.*, 1937, V. 31, Col. 6886.

During the carbonization of some black woolen Tibet rags it was found that a portion of these rags remained black while the other part turned reddish brown. Tests were made to det. the cause of this color change. The results show that all wool to be carbonized must be resistant to acids and the carbonization treatment. The acid used must be completely neutralized. Any changes in color caused by carbonization can (1) be allowed to remain, (2) be changed back to the original color and (3) be altered to a different color by subsequent aftertreatments. (W)

Bleaching of Textile Materials. "Bleacher." *Tex. Col.*, Aug. 1937, P. 522–24 (reprinted from *Textile Mercury and Argus*).

A review of recent developments in methods used for vegetable and animal fibres. (C)

Cellulose Fibres: Action of Liquid Ammonia on. K. Hess and J. Gundermann. *Ber.*, 1937, V. 70, P. 1788–99; abs. in *J. Soc. Dyers Col.*, Nov. 1937, P. 454. (C)

Chemistry of Silk and Silk Processing: Recent Developments in the. Walter M. Scott. *Am. Dye. Rptr.*, Nov. 29, 1937, P. 756–58, 770–77.

This article is the fourth in a series of reviews which have appeared in this journal under the same title. These reviews summarize the progress

which has been made in connection with the fundamental chemistry of raw silk and the chemical processes which play a part in the transformation of the raw silk into finished fabric. The present review brings the story through the years 1936 and 1937. (C)

DELUSTERED YARNS OR FABRICS. H. Roche. *Tex. Mfr.*, Aug. 1937, P. 330–31.

A review of recent methods of producing delustered rayon or acetate yarns by treatment of spinning solution, yarn or fabrics. (C)

DETERGENT, EMULSIFYING, FINISHING AND WETTING AGENTS. DATA ON COMPOSITION, PROPERTIES AND USES, PARTICULARLY OF NEWER MATERIALS IN THESE OVERLAPPING FIELDS. Charles F. Goldthwait. *Am. Dye. Rptr.*, Sept. 20, 1937, P. 569–80.

This paper is essentially a collection of published data on many of the newer textile processing agents. Scattered information from many sources, mainly foreign publications, has been gathered in an effort to present definite statements on the nature of these materials and properties of their solutions, and on the uses for which they are claimed to be suitable. (C)

DYEING AND FINISHING OF FULL FASHIONED HOSIERY: DEVELOPMENTS AND PROBLEMS IN. Chester W. Meyers. *Am. Dye. Rptr.*, Nov. 29, 1937, P. 728–29. (C)

DYEING OF CRÊPE FABRICS. E. Ebbinghaus. *Klepzig's Textil-Z.*, 1937, V. 40, P. 411–12, 414; abs. in *C. A.*, 1937, V. 31, Col. 6467.

The phys. and chem. treatments are discussed and numerous Sirius and diazo dyes suitable for this purpose are listed. (W)

DYEING OF MIXED SPUN-RAYON TEXTILES. W. Pflumm. *Klepzig's Textil-Z.*, 1937, V. 40, P. 445–6; abs in *C. A.*, 1937, V. 31, Col. 6887.

A description of phys. and chem. treatments. (W)

DYES OF OUR ANCESTORS. Wm. H. Cady. *Am. Dye. Rptr.*, Sept. 6, 1937, P. 539–43.

Paper presented at a meeting of the R. I. Section, A. A. T. C. C., Feb. 26, 1937, and at a meeting of the Northern N. E. Section Mar. 5, 1937. (C)

FIREPROOFING FABRICS. *Am. Dye. Rptr.*, Nov. 15, 1937, P. 700.

Reprint of an article in *Chemical Age* reviewing some recent developments and suggestions. (C)

HYPOSULFITE COMPOUNDS. Karl Volz. *Klepzig's Textil-Z.*, 1936, V. 39, P. 587–8; abs. in *C. A.*, 1937, V. 31, Col. 6470.

The constitution, properties and uses in the textile industry of $Na_2S_2O_4$, its condensation product with $CH_2O$, and some related derivs. are reviewed. A list of hyposulfite derivs. produced by I. G. Farbenindustrie is given. (W)

LATEX: USES OF—IN THE TEXTILE INDUSTRY. Ernst A. Hauser. *Rayon Tex. Mo.*, Sept. 1937, P. 107–9. (C)

MERCERIZATION PROCESS: STUDY OF THE. III. EFFECT OF CAUSTIC TEMPERATURE AND IMPURITIES IN THE CAUSTIC. Sidney M. Edelstein. *Am. Dye. Rptr.*, July 26, 1937. (C)

MERCERIZATION: PROGRESS IN TECHNIQUE OF. O. Schmidhäuser. *Tex. Mfr.*, Oct. 1937, P. 421, 423; *Tex. Col.*, Jan. 1938, P. 24–5.

A review of German work on the mercerization of staple fibre goods and mixtures with cotton, and knowledge of the process thereby obtained. (C)

MODERN THICKENINGS. J. A. Kiernan. *J. Soc. Dyers Col.*, Oct. 1937, P. 379–80.

Describes the character, and use in printing pastes of "Solvitex BG and ST," and "Nafka Crystal" gum. (C)

OXIDATION IN THE DYESTUFFS INDUSTRY. F. Henesey. *J. Soc. Dyers Col.*, Sept. 1937, P. 345–47. (C)

OSMOTIC-BLEACHING PROCESS. Bernhard Teufer. *Klepzig's Textil-Z.*, 1936, V. 39, P. 598–9; abs. in *C. A.*, 1937, V. 31, Col. 6471.

The process involves a vat bleach in which the textile material is not immersed in the bath but is sprinkled with the liquor by means of a Seeger water wheel. The phys. and chem. details of this process are fully described. Thorough preboiling is required. This process can be installed in old as well as new bleaching plants. (W)

PERMANENTLY WATER REPELLENT TEXTILES. Samuel Lenher. *Am. Dye. Rptr.*, Nov. 29, 1937, P. 785–86.

Describes application and results of a new water-repelling finish developed by E. I. du Pont de Nemours & Co. (C)

PEROXIDE BLEACH FOR COTTON AND FOR RAYON MIXTURES. H. Baier. *Tex. Mfr.*, Oct. 1937, P. 424, 427.

A German review of the position of peroxide bleaching and various processes in which it may be used. (C)

PHYSICAL CHANGES CAUSED BY MERCERIZATION (OF MIXTURES OF SPUN RAYON AND COTTON). O. Schmidhäuser. *Klepzig's Textil-Z.*, 1937, V. 40, P. 390–2; abs. in *C. A.*, 1937, V. 31, Col. 6470. (W)

RAWSTOCK DYEING: CONTROL OF VARIABLES IN. J. H. O'Neill. *Am. Dye. Rptr.*, Sept. 6, 1937, P. 545–46.

Paper presented at Spring meeting, Southeastern Section, A. A. T. C. C. (C)

RAYON SPINNING: PRODUCING COLORED FILAMENTS IN. G. LePage. *Rayon Tex. Mo.*, Oct. 1937, P. 53–4.

Reviews various patented processes having this objective, and describes the Dosne process and its advantages in some detail. (C)

RESIN FINISHING OF TEXTILE FABRICS: PROGRESS IN THE. D. H. Powers. *Am. Dye. Rptr.*, Nov. 29, 1937, P. 783–5. (C)

SAPONIFYING ACETATES. Philip LeBrun. *Tex. Wld.*, Nov. 1937, P. 119.

Methods and chemicals for treating fabrics to be discharge printed. (C)

SIZE OF THE PARTICLES IN DYE SOLUTIONS AND ITS SIGNIFICANCE FOR THE DYEING PROCESS. E. Valko. *Monatsh. Seide Kunstseide*, 1937, V. 42, P. 270–1; abs. in *C. A.*, 1937, V. 31, Col. 6467. (W)

SLUBBING DYEING. Edgar Isles. *J. Soc. Dyers Col.*, Nov. 1937, P. 417–24.

In part a review of progress during the last 50 years; also a discussion of dye fastness in processing and in finished materials, and of problems peculiar to slubbing dyeing. (C)

SPUN RAYON-WOOL MIXTURES: DYEING AND FINISHING OF. H. C. Borghetty. *Am. Dye. Rptr.*, Nov. 29, 1937, P. 726–7. (C)

VELAN PF WATER-REPELLENT PERMANENT FINISHING AGENT. *Tex. Mfr.*, Nov. 1937, P. 464, 470–71. (C)

WATERPROOFING IMPREGNATIONS RESISTANT TO WASHING. *Seide u. Kunstseide*, 1937, V. 42, P. 210–13; *J. Soc. Dyers Col.*, Sept. 1937, P. 369.

Textiles, which have been impregnated with benzine solutions of precipitated aluminium palmitate or stearate, exhibit exceptionally highly porous waterproofed effects, characterized by a higher resistance to washing than those produced by other methods. This increased resistance to washing is attributed to the fact that the fabrics are proofed in absence of water by means of salts insoluble in water, and microscopic examination of the fibre cross-sections indicated that the aluminium salts are not only deposited on the fibres, but have also penetrated beneath the surface. The simultaneous delustering produced by the use of aluminium stearate or palmitate in waterproofing is, in some cases, an added advantage. (C)

WETTING, EMULSIFYING, DISPERSING, AND CLEANSING COMPOUNDS AND MIXTURES, AND OTHER TEXTILE ASSISTANTS. RECENT PATENTS COVERING. Charles E. Mullin. *Tex. Col.*, 1937, Aug., P. 531–33, 558; Sept., P. 599–602; Oct., P. 693–96, 708; Nov., P. 762–64; Dec., P. 811–14. (C)

WOOL: ACTION UPON—OF HYPOCHLORITES, SODIUM BISULFITE, HYDROGEN PEROXIDE AND CAUSTIC SODA. E. Justin-Mueller. *Teintex*, 1937, V. 2, P. 394–8; abs. in *C. A.*, 1937, V. 31, Col. 6890. (W)

## IV. RESEARCH METHODS AND APPARATUS

AIR PERMEABILITY TESTER. Schmerber and Tournafond. *Fils et Tissus*, 1937, V. 25, P. 309–13; abs. in *J. T. I.*, Sept. 1937, P. A511.

Details are given of an apparatus for measuring the "closeness" of a fabric by means of its permeability. The fabric closes the end of a cylinder in which pressure or a partial vacuum is created by a pump or aspirator working at a controlled speed, and the pressure in the cylinder is indicated by a sensitive manometer. (C)

ELONGATION AND STRENGTH MEASUREMENTS ON SINGLE FIBRES, PARTICULARLY SPUN RAYONS. W. Weltzien, H. Biermann and E. Husung. *Monatsch. Seide Kunst.*, 1937, V. 42, P. 302–8; abs. in *C. A.*, 1937, V. 31, Col. 7658.

Tensile-strength and breaking-elongation data are presented for various spun rayons. The phenomenon of elongation is discussed and results obtained in elongation expts. at const. load are expressed in spatial co-ordinates. The influence of a slight variation in air humidity is described in detail. The elastic after-effect is detd. and represented by means of a space model. Max. load-elongation curves (isochrones) are shown. (W)

DYES: ANALYSIS OF. Jean Deshusses. *Mitt. Lebensm. Hyg.*, 1937, V. 28, P. 115–6; abs. in *C. A.*, 1937, V. 31, Col. 8931.

While pure single dyes can be characterized by their color in dil. and coned. acids, 10% NaOH, etc., and on wool, these methods are not satisfactory when applied to mixed dyes. For analysis of dye mixts., a small quantity of the dry material is blown onto asbestos, where the constituents sep., each forming a characteristic stain which may be analyzed as pure dyes. As an alternative method, a small quantity of the dry material may be dropped into a porcelain vessel 10 cm. in diam., filled with water. The small grains remain at the surface, each forming a stain which can be picked up separately in a capillary tube and analyzed. (W)

FIBRES: LENGTH MEASUREMENT. J. Desprez. *L'Ind. Text.*, 1937, V. 54, P. 274–5; abs. in *J. T. I.*, Oct. 1937, P. A574.

Various methods and apparatus for the measurement of the length of fibres, including those of Cobb, Sever, Balls, Baer, Chandler, Kühn-Meyer, Deltour, and Ahmad and Nanjundayya, are briefly described. (C)

FRICTION OF FIBRES: MEASURING THE. H. J. Henning. *Mell. Textilber.*, 1937, No. 12, P. 945.

The author describes a new process for measuring fibre friction by employing the damping of an oscillating system by means of the pressure of two fibres upon one another. The results show that the coefficient of friction of wool does not depend on the thickness of the fibre and only to a slight extent upon the country of origin, the lubricant, and the dyeing process. The coefficient of friction of wool falls off as the fibre pressure increases. The various types of staple fibre behave like wool freed from its scales. Their coefficient of friction is lower than that of wool when sufficient grease is present, but may assume relatively high values when the size, lubricant, and so on have been removed. Comparisons between the coefficient of friction and the results of combing various types of staple fibre that had been lubricated in different ways proved by their parallelism how important fibre friction is for the working qualities of staple fibre. The friction did not depend upon the denier and there was no appreciable difference between lustrous and dulled fibres, because the particles of the matting agent are covered by regenerated cellulose. The dyeing process may only be expected to have an effect upon the friction of staple fibres when the agent used for their preparation is deleteriously affected. (C)

MORPHOLOGY OF RAYONS AND SPUN RAYONS. H. Reumuth. *Monatsh. Seide Kunst.*, V. 42, P. 296; *Deut. Wollen-Gewerbe*, V. 69, P. 858–9; *Spinner u. Weber*, V. 55, No. 31, P. 8 (1937); abs. in *C. A.*, 1937, V. 31, Col. 7658.

The newly developed so-called R–O–X method is suitable for the study of the surface structure of fibres. It depends on the semi-lateral imbedding of the fibres so that the upper side can be examd. under transmitted light microscopically without the use of a cover glass. (W)

MICROCHEMICAL METHOD FOR DETERMINATION OF ACID CHARACTER OF ORGANIC DYES. D. Reichinstein. *Helv. Chim. Acta*, 1937, V. 20, P. 882–3; abs. in *C. A.*, 1937, V. 31, Col. 8931.

A basic dye (Fuchsin, Methylviolet-N Blue, Auramin O, etc.) shaken in a test tube with melted urea (m. 132.7°, sp. gr. 1.335) and stearic acid (m. 69.3°, sp. gr. 0.94) colors the upper layer while an acid dye (Azodye Ponceau 2R, Naphthol Yellow) colors the lower layer. The method can be used only as a microchem. method since larger quantities color both layers. The acid character of dyes is proved also by adsorption on inorg. substrata. The principle can be used for the sepn. of a dye mixt. (W)

PHOTOMETER FOR THE MEASUREMENT OF THE LUSTRE OR GLOSS OF TEXTILE AND OTHER MATERIALS. PART I. CONSTRUCTION OF INSTRUMENT. D. A. Derrett-Smith. *J. T. I.*, Sept. 1937, P. T293–T298.

A compact and portable instrument is described for the evaluation of the lustre of textile and other materials by comparing the brightness of the surface under examination with that of a standard white surface (barium sulphate) under the same conditions of illumination. Provision is made whereby observations may be made at a number of angles for a given angle of incidence of the illuminating beams. In addition, the angle of incidence of the latter may also be varied. Measurements may be carried out by placing the instrument on the test surface without the necessity of cutting a sample from the latter. (C)

RAYON WARP-KNIT FABRICS: SOFTNESS TEST. H. Lohmann and P. Braun. *Textilberichte*, 1937, V. 18, P. 347; abs. in *J. T. I.*, Aug. 1937, P. A453.

The "softness" of fabrics is measured by slowly drawing strips, 50 cm. × 3 cm. under a load of 450 gm., over a piece of tailor's chalk cut to an edge of 22°, and measuring the loss of weight of the chalk. Some results are recorded for warp-knitted rayon fabrics of comparable construction that indicate the superior "softness" of acetate rayon. The apparatus is illustrated. (C)

STEREOSCOPIC RADIOGRAPHY OF CLOTH. H. F. Sherwood. *J. T. I.*, Oct. 1937, P. T299–T304.

The stereoscopic radiography of cloth provides a method whereby the weave, suitably enlarged, can be visualized in its correct spatial relationships, and should be particularly valuable in analyzing complex weaves. (C)

STRENGTH AND STRETCH MEASUREMENTS ON TWISTED SPUN-RAYON FIBRES. E. Husung. *Monatsh. Seide Kunst.*, 1937, V. 42, P. 215–8, 273–4, 276; abs. in *C. A.*, 1937, V. 31, Col. 7658.

The results of various phys. measurements are tabulated and discussed. Torsion was found to lower the longitudinal strength and stretch properties of the textile. (W)

TEXTILES: SERVICEABILITY TESTS. H. Sommer. *Mitt. deut. Materialprufungsanstalten*, 1937, No. 21, P. 330; abs. in *J. T. I.*, Aug. 1937, P. A453.

A brief review is given of routine tests for resistance to wear, weathering, creasing and rain, and thermal properties, in use in Germany. (C)

TESTING OF TEXTILES. Scheithauer. *Deut. Textilwirtschaft*, 1937, V. 4, No. 17, P. 5–10; abs. in *C. A.*, 1937, V. 31, Col. 8204.

A discussion of detg. various phys. properties of textiles. The results of tests are shown in 17 charts. (W)

WATERPROOFED FABRICS: TESTING. O. Mecheels. *Textilberichte*, 1937, V. 18, P. 312–3; abs. in *J. T. I.*, Aug. 1937, P. A453.

A method of testing waterproofed fabrics is briefly described in which the underside is rubbed to and fro by a metal plate while the top surface receives the "rain." The cloth is clamped in a ring and slightly inclined; the time that elapses before a drop of water appears on the under side is observed. The test is coupled with the Schopper test of the pressure required to force water through the cloth. If two cloths are equal in the pressure test but one is better in the "rain" test, the presumption is that the impregnating agent has penetrated further in the better cloth. A better effect from this point of view is obtained by adding clay to a paste of glue, paraffin, soap and aluminium acetate and then diluting than by diluting the emulsion before adding the clay. (C)

WOOD'S LIGHT: APPLICATION OF—TO THE TEXTILE INDUSTRY. P. Korda and M. Deribere. *Tech. moderne*, 1937, V. 29, P. 355–9; abs. in *C. A.*, 1937, V. 31, Col. 7655.

Wood's light aids in the identification of fibres. (W)

WOOL: RAPID COLORIMETRIC DETERMINATION OF FAT CONTENT OF. E. K. Zilberkveit and L. A. Vasiliev. *J. Appl. Chem. Russ.*, 1937, V. 10, P. 570–7 (through *Brit. Chem. Abs. B.*, 1937, V. 56, P. 765); abs. in *J. T. I.*, Oct. 1937, P. A591.

0.5 g. of wool is extracted with 5 ml. of boiling $CHCl_3$ or $CH_2Cl_2$ for 5 mins., the solution filtered, the extraction repeated, and the extracts + washings are diluted to 25 ml. Then 1 ml. of $Ac_2O$ and 10 drops of concentrated $H_2SO_4$ are added to 5 ml. of solution, and the coloration developing after 3 min. is compared (blue filter) with that of a standard [4.5 g. of $K_2Cr_2O_7$ and 762 g. of $Cu(NO_3)_2$, $3H_2O$ in a litre of solution, the coloration of which corresponds with that given by 0.25% of lanoline in $CHCl_3$]. (C)

## V. Economic Research and Miscellany

Developments in Research and Education. Louis A. Olney. *Am. Dye. Rptr.*, Nov. 29, 1937, P. 721–22.

Describes researches of the A. A. T. C. C. and the new chemical laboratory to be built at Lowell (Mass.) Textile Institute. (C)

Graduate Institute of Textile Research. Elvin H. Killheffer. *Am. Dye. Rptr.*, Nov. 29, 1937, P. 719–21; *Tex. Rsch.*, Dec. 1937, P. 68–71; *Tex. Col.*, Dec. 1937, P. 819–20; *Tex. Wld.*, Dec. 1937, P. 73. (C)

Personnel Departments. J. O. Thomas. *Am. Wool & Cotton Reporter*, Oct. 21, 1937, P. 17–18, 30.

Textile mills giving more attention to programs of industrial relationships; what personnel work embraces; selecting right persons to head program; forms used. (C)

Pulp Bleaching Under Ultra Violet Light. W. Hirschkind with D. J. Pye and E. G. Thompson. *Paper Trade J.*, Oct. 28, 1937, P. 118–19.

A review of Escourrou's theories of the effect of ultra violet light on the bleaching reaction in pulp and a report of tests made to determine the optimum condition of using such light. (C)

Research of U. S. Institute for Textile Research. Chas. H. Clark. *Am. Dye. Rptr.*, Nov. 29, 1937, P. 722–23. (C)

Spindles and Gyroscopes. *Mell. Textilber.*, 1937, No. 11, P. 861.

Erroneous views are often to be met with on the behaviour of modern spindles that are not mounted in bearings and are free to execute a travelling movement. A freely suspended spindle rotates in accordance with the laws of rotation about the axis of its maximum moment of inertia, which does not coincide with that of the spindle stem. Consequently the rotating part of a spindle would revolve about the free axis owing to disturbing forces, if the bearing were not present. The spindle bearing has thus not only the object of absorbing the forces of the bands and tapes, but must also counteract dynamic forces that tend to be greater, the more defective the balancing of the spindle and the bobbin. The damping action of the brake ring spindle, in which fluid friction and mechanical friction cooperate harmoniously, may serve as a model.

Starch Products for Textile Trades. "Technologist." *Tex. Recdr.*, Sept. 6, 1937, P. 48.

Refers briefly to methods of manufacture that determine quality of product. (C)

Treatment of Textile Wastes: Recent Progress in. Foster Dee Snell. *Am. Dye. Rptr.*, Nov. 29, 1937, P. 730. (C)